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New consumer services provided by smart metering

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Abstract. This paper focuses on the issues of smart metering market and considers different services provided by smart metering from consumer point of view. Firstly, smart metering deployment challenges emerging and conventional tariffs, which modify a consumer behavior and thus, the entire electric energy market can be optimized since the customer is motivated to consume less energy. Secondly, the authors illustrate changes in electricity quality, which have an impact on consumer relations with utility. Additionally, two main indices of grid resilience – SAIDI and SAIFI – are exemplified to reveal the improvement potential of smart metering implementation in certain regions of Russia that also influence the consumer. Finally, in-home display and privacy problem directly reflect the consumer's behavior, thus the private life rights should not be violated as they are guaranteed by law.

1 Introduction

Modern realities induce to the transformation of electrical grid into a smart grid. The first stone, which could be established towards a new age is smart metering. Having a lot of benefits with their appearance smart meters push the development of not only electrical grid but also ICT technologies creating close links between different technological areas. Stakeholders are various actors starting from utilities and finishing by consumers. Everyone benefits from this technology. According to Transparency Market Research, the global smart metering market revenue will reach \$19.8 billion by 2018 [1]. This huge growing market will stipulate the development of new emerging services. The main goal of our research is to study the deployment potential of smart meters from the consumer's aspect on the example of the Russian Federation system.

2 Consumer services

Traditionally, the first benefit for a consumer is service delivery of accurate bills for energy consumption. Consumers pay for their energy. Previously consumers could see only cumulated consumed energy quantity for 1 month or sometimes even for 1 year; however with a smart metering it becomes possible to see when and how much electricity was used i.e. a load profile of each consumer. This service creates the opportunity to implement advanced tariffs such as real-time tariffs taking into account spot prices on the market [2-4], block tariff with a different rate depending on

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demand level for defined period and also working capital tariffs based on consumer debt or credit, time of use system (TOU system). The TOU tariff system has basically a day and a night rate with only a slight price difference [5, 6]. However, additionally a third period during evening peak time is distinguished, with a substantially higher price than during the rest of the day (although the prices given are considered to be indicative). In such a tariff system, a shifting demand from the peak period into the normal day rate period would already generate significant savings of consumer money. Except for savings, smart metering gives a chance to earn money. For instance, henceforth electricity produced from PV plant and delivered to the grid can be precisely measured and thereby rewarded to a consumer. Such schemes of bilateral cash flows open new way to demand response programs, creation of a new market player such as an aggregator which is managing consumer potential to increase or decrease consumption in peak times and providing a reward to consumer for doing that and creating a new vision from the point of view of a customer that being energy effective can be profitable.

Another essential part is the quality of electricity. A smart meter can provide full information on supply voltage levels, quality of waveform power such as under voltage, dips, sags, flickers, harmonics, frequency, transients etc. Many of these quality indexes have a large value for sustainable and durable usage of consumer's equipment. Subsequently, if there is a divergence of quality parameters from those written in GOST 13109-97 «Electric energy. Electromagnetic compatibility of technical equipment. Power quality limits in public electrical systems» then it can lead to a lifetime reduction of equipment or even to its damage. Washing machines, refrigerators are especially sensitive to that. In other words, if consumer's refrigerator or another equipment is damaged the reason of this could be low-quality electricity supply. Besides, the divergence of these indexes (flicker) can have an impact on human health. Flicker effect of light flux can cause a visual fatigue of a human being [7]. According to the RF Government Decree from 06.05.2011 №354 in relevant cases, the cost for electricity can be 0 RUB. Equipped with historical data from the smart meter a consumer can prove easily the fact of discrepancy in quality and thereby be rewarded. Ideally, it should be done automatically without any consumer additional contacts with utility.

Nowadays, distribution company (“ROSSETI” company in Russia) has key performance index (KPI) system including SAIDI (System Average Interruption Duration Index) and SAIFI (System Average Interruption Frequency Index) showing an outage duration per customer per year (SAIDI) and a number of permanent outages per customer per year (SAIFI) correspondingly. Since smart meter has two-way communication with utility it means when outage occurs at that moment distribution system operator can precisely define an area without power supply for example by sending automatic checkback signals to smart meter since smart meters with outage will not response; by doing so a problem identification time is reduced as well as SAIFI and SAIDI. For the consumer, it means fewer outages and their less duration, which are an additional benefit of smart meters. The best world example is represented by Singapore with SAIDI=0.42 min per customer per year and SAIFI=0.0087 interruptions per customer per year. In other words, the average electricity customer would experience an interruption only once in 115 years. [8] Table 1 presents SAIDI and SAIFI critical values across Russian interregional distribution grid companies (IDGC) [9]. There is a big potential for improvement especially for IDGC of Northern Caucasus and IDGC of Centre where SAIDI/SAIFI values are extremely high. Nevertheless, data collecting has been started recently and can be inaccurate and not full.

Table 1. SAIDI/SAIFI in different interregional distribution grid companies of Russia

Parameters	Unit	IDGC of Northern Caucasus	IDGC of Centre
SAIFI	Quantity per year	474,6	10
SAIDI	Min per year	345 944,5	494

In-home display (IHD) is a device communicating with smart meter via a wireless network and showing related information about customer's energy consumption. In most current smart meter roll-outs, this device is still optional. However, it possesses a high potential, which can turn the page and improve drastically a customer relationship management (CRM) directions in power engineering area. Though IHD itself is not new in smart metering but with its potential functionality, it is possible to create added value for the consumer.

The one way to inspire a consumer to become green-minded and energy effective in modern market relations in our society is to provide particular benefit in return to green actions. It should be something perceivable especially within a short term period, which will give the consumer a motivation to continue these green actions and he/she will be able to see and experience the result sooner. By means of IHD consumer sets own targets of energy consumption and demand for 1 month. If at the end of selected period all planned targets are reached then the consumer is granted by a particular number of points. Further, these points are exchanged for a free product, discount or another benefit from Partner Company, transforming it in those perceivable results of consumer energy effective actions. Such system will engage not only the consumer but also companies, which will have marketing interest in this activity. Such systems are under development by world largest firms e.g. ATOS World grid.

Another way to give something back to the consumer is to show green tips in the IHD screen. There can be common tips convenient for every person or individual based on consumer own load profile. The important issue for this case is confidentiality. Generally, the idea of giving tips is that firstly, the consumer gets information from smart meter about the consumption during some time and after he/she gets information from utility how to improve it. The load profile is the element from which it is possible to obtain information on private life e.g. when consumer wakes up, comes back from a work or drinks tea etc (Fig. 1). The potential domain of load profile application is ubiquitous. Except the area of power engineering industry such load profile could be used during a court examination proving directly or impliedly the words of lawyer for example that nobody wasn't at home because of consumption absence. However, it creates under some circumstances the opportunity of data hacking, leakage or even a spying. For instance, there are two rival IT companies on the market. The first one has installed the new data center and the company keeps this in secret since this data center provides a competitive position. Nevertheless, the second company having obtained the load profile of first company can analyze it and reveal the presence of new data center what can result in strategy changing and market position loss for the first company. There is a solution to make a bigger interval between meter readings which dithers a data profile making it less possible to identify particular events.

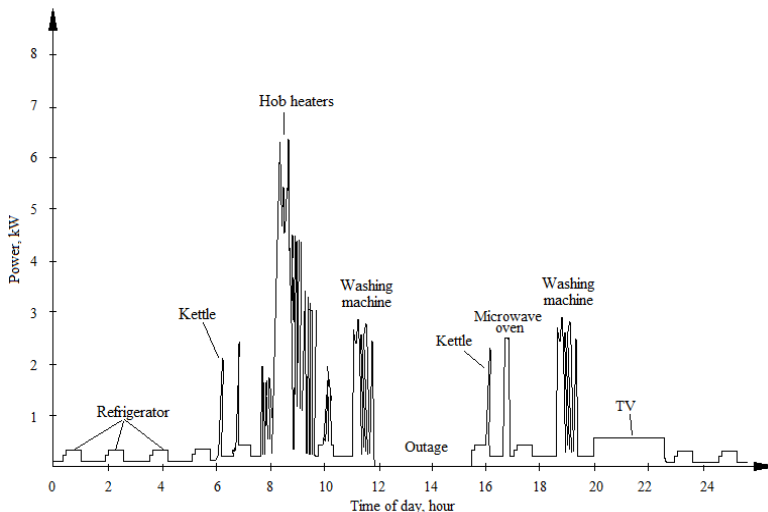


Figure 1. Load profile example describing what was on during a day

3 Conclusion

Creation of new market player – aggregator, implementation of demand response programs, and subsequently creating a platform for smart homes and even smart cities are future trends favored by smart meter deployment. Incipient tariffs will stipulate a new consumer behavior. Energy quality issues play an important role in consumer comfort level and now it can be measured by consumer imposing a new high level of customer – utility relationships. Outage duration and its frequency are going to decrease because of the faster technique of problem identification. Besides smart meter consumer is able to change a supplier more easily promoting more competition among supplier companies.

With a growing market of smart metering, new services emerge as well. Using IHD or online applications it becomes possible to motivate a consumer by providing particular benefits for their green efforts, which are done for the first time and such exchange model has a huge potential in term of engagement of different companies striving for their marketing interests. However, the privacy issue remains as an open question and there is an apprehension that smart metering can become a spy tool for mala fide parties.

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